FREQUENCY SYNCHRONIZATION DEVICE FOR LCD LAMPS

FIELD OF THE INVENTION

The present invention relates to LCDs (liquid crystal displays) and more particularly to an improved frequency synchronization device for an LCD having a plurality of lamps (e.g., fluorescent lamps) as background light source.

BACKGROUND OF THE INVENTION

LCDs are gaining popularity in recent years. Also, more LCDs having a larger screen size are commercially available. Further, applications of LCD are diversified. A typical application thereof is LCD TV (television). It is understood that light intensity of LCD background is required to increase for improving video quality as the screen size of LCD increases. Accordingly, more lamps (e.g., fluorescent lamps) are mounted in LCD for providing a sufficient light intensity of LCD background.

Conventionally, frequency synchronization among a plurality of lamps is required in controlling the operation of LCD lamps. Otherwise, a difference frequency distortion may occur between any two adjacent lamps, resulting in a flickering of the LCD screen.

Typically, ICs (integrated circuits) are used for controlling a frequency synchronization operation of the plurality of lamps. Such controlling is called active synchronous drive. The provision of a plurality of ICs is for the purpose of carrying out frequency synchronization among the lamps in operation. In detail, the ICs

operate to output driving signals of the same frequency to respective lamps so that all lamps can operate in the same frequency.

A well known frequency synchronization device for an LCD having a plurality of LCDs (three as shown) is shown in Fig. 1. For any single lamp (e.g., first lamp 14a) (i.e., single lamp operation implementation), associated components such as a control element 11a, a driving element 12a, and a first power amplification unit 13a are provided. The control element 11a is adapted to control current of the first lamp 14a and provide protection against open circuit. Output signals of the control element 11a are sent to the first power amplification unit 13a for driving via the driving channel 12a. The first power amplification unit 13a comprises a DC (direct current) power 131a, a first power switch 132a, and a transformer 133a in which the first power switch 132a is adapted to convert DC into AC (alternating current) prior to outputting to the transformer 133a, and the transformer 133a is adapted to boost the AC voltage for activating the first lamp 14a. Each of the control elements 11a, 11b and 11c is implemented as an IC. Further, a synchronous signal bus 10 is provided to connect all of the control elements 11a, 11b and 11c together while providing synchronous signals thereto. Thus, all lamps 14a, 14b and 14c can operate at the same frequency as driven by synchronous signals fed from the control elements 11a, 11b and 11c via the driving channel 12a, 12b and 12c and the first, second and third power amplification units 13a, 13b, and 13c respectively.

Timing among the control elements 11a, 11b, and 11c is controlled by the synchronous signal bus 10. As such, the IC based control elements 11a, 11b, and 11c are very complicated in the design phase for achieving the timing control purpose. To the worse, more control elements are required as the number of lamps increases. This may further complicate the circuitry for controlling such many lamps. Also, associated components are required to operate in conjunction with IC based control elements for carrying out frequency synchronization. This can incorporate an excessive number of components in the circuitry and greatly increase the manufacturing cost. Thus, the need for improvement still exists.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a frequency synchronization device for a large LCD having a plurality of lamps as a background light source, comprising a plurality of power driving assemblies arranged in loop, each power driving assembly being electrically coupled to one of the lamps, adapted to generate a synchronous signal, and adapted to send the synchronous signal to the coupled lamp for causing the lamps to operate at the same frequency; a plurality of current sampling elements each electrically coupled to one of the lamps for sampling current thereof; and control means comprising a control element and a diode, the control means being electrically coupled to current sampling elements so as to stabilize the current of the lamps. By utilizing the present invention, following advantages are obtained. A secondary winding

of multicoil of a transformer is used as means for initiating and sending synchronous signals to the lamps so that all lamps can operate in the same frequency. Synchronous signals having the same frequency can be generated without the provision of ICs as experienced in the prior art. Both connection and circuitry of the frequency synchronization device are much simplified. The synchronous signals having the same frequency are generated by a resonant chamber consisting of transformers and capacitors. Typical lighting loop of a plurality of fluorescent lamps are incorporated into the circuitry of the present invention and are improved by the present invention. Availability of constituent components is much easy and thus the manufacturing cost is reduced significantly. It is applicable to an LCD having more than two lamps. Lamp current can be effectively controlled and stabilized by incorporating a cost-effective lamp control circuit. Finally, it is much simplified in terms of the frequency synchronization control of lamps.

The above and other objects, features and advantages of the present invention will become apparent from the following detailed description taken with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a schematic block diagram of a conventional frequency synchronization device for LCD lamps.

Fig. 2 is a schematic drawing of the driving circuitry of a frequency synchronization device for LCD that uses two lamps according to the invention.

Fig. 3 is a schematic drawing of the driving circuitry of a frequency synchronization device for LCD that uses three lamps according to the invention.

Fig. 4 is a schematic block diagram illustrating the connection of three power amplification units and three lamps according to the invention.

Fig. 5 is a graph illustrating waveshapes of voltage versus time for signals of three lamps and a first driving signal.

Fig. 6 is a schematic drawing of the circuitry of a frequency synchronization device for LCD that uses three lamps according to a first preferred embodiment of the invention.

Fig. 7 is a schematic drawing of the circuitry of a frequency synchronization device for LCD that uses more than three lamps according to a second preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 2, there is shown a driving circuitry of a frequency synchronization device for an LCD that uses two lamps according to the invention. As shown, a power driving assembly of a first lamp 27a comprises a DC power 20, power amplification elements 25a and 25b, capacitors 22a and 23a, an inductor 26a and a transformer 21a. Likewise, a power driving assembly of a second lamp 27b comprises the DC power 20, power amplification elements 25c and 25d, capacitors 22b and 23b, an inductor 26b and a transformer 21b. The characteristics of the invention are detailed

as follows. Driving signals of the power amplification elements 25a and 25b are fed from a portion of a secondary winding of multicoil (i.e., from pins 1 and 6) of the transformer 21b. Output signals of the transformer 21b are sent from pin 1 to the power amplification element 25b for conducting via a conducting wire 28a. Also, output signals of the transformer 21b are sent from pin 6 to the power amplification element 25a for conducting via a conducting wire 28b. Similarly, driving signals of the power amplification elements 25c and 25d are fed from a portion of a secondary winding of multicoil (i.e., from pins 1 and 6) of the transformer 21a. Output signals of the transformer 21a are sent from pin 1 to the power amplification element 25d for conducting via a conducting wire 28d. Also, output signals of the transformer 21a are sent from pin 6 to the power amplification element 25c for conducting via a conducting wire 28c. In configuring as above, the first lamp 27a and the second lamp 27b can be operated at the same frequency.

Referring to Fig.3, there is shown a driving circuitry of a frequency synchronization device for an LCD that uses three lamps according to the invention. The configuration substantially has same structure as the above one. The characteristics of this configuration are detailed below. Driving signals of the power amplification elements 25a and 25b are fed the transformer 21c via the conducting wires 28a and 28b. Driving signals of the power amplification elements 25c and 25d are fed the transformer 21a via the conducting wires 28c and 28d. Driving signals of the power

amplification elements 25e and 25f are fed the transformer 21b via the conducting wires 28e and 28f. This forms an operating loop.

Referring to Fig. 4, there is shown a schematic block diagram illustrating the connection of three power amplification units 40, 41, and 42 and three lamps 43, 44, and 45 according to the invention. Each of the power amplification units is a well known device as described in Fig. 1 in which the first power amplification unit 40 comprises a DC power 401, a power switch 402, and a transformer 403; the second power amplification unit 41 comprises a DC power 411, a power switch 412, and a transformer 413; and the third power amplification unit 42 comprises a DC power 421, a power switch 422, and a transformer 423 respectively.

One of the characteristics of the invention is that a first driving signal 46 is outputted from the first power amplification unit 40 to the second power amplification unit 41 for controlling, a second driving signal 47 is outputted from the second power amplification unit 41 to the third power amplification unit 42 for controlling, and a third driving signal 48 is outputted from the third power amplification unit 42 to the first power amplification unit 40 for controlling respectively. This forms a control loop.

Referring to Fig. 5 in conjunction with Fig. 4, voltage operation signals 51, 52, and 53 of the lamps 43, 44, and 45 and the first driving signal 46 are shown. In detail, the voltage operation signal 51 of the second lamp 43, the voltage operation signal 52 of the second lamp 44, and the voltage operation signal 53 of the second

lamp 45 are the same in both voltage and frequency. The first driving signal 46 consists of two alternate waveforms 55. Each of the second and the third driving signals 47 and 48 is the same as the first driving signal 46 in both voltage and frequency because, as stated above, the voltage operation signal 51, 52, and 53 of the lamps 43, 44, and 45 are the same.

Referring to Fig. 6, there is shown a schematic drawing of the circuitry of a frequency synchronization device for LCD according to a first preferred embodiment of the invention. As stated above, the power driving assembly of the first lamp 27a comprises a DC power 20, power amplification elements 25a and 25b, capacitors 22a and 23a, an inductor 26a and a transformer 21a. This is the configuration of an LCD having a single lamp. By applying this to an LCD having a plurality of lamps as implemented by the invention, driving signals of the power amplification elements 25a and 25b can be obtained accordingly. In detail, conduction signals of the power amplification elements 25c and 25d are fed from a portion of a secondary winding of multicoil (i.e., from pins 1 and 6) of the transformer 21a, conduction signals of the power amplification elements 25e and 25f are fed from a portion of a secondary winding of multicoil (i.e., from pins 1 and 6) of the transformer 21b, and conduction signals of the power amplification elements 25a and 25b are fed from a portion of a secondary winding of multicoil (i.e., from pins 1 and 6) of the transformer 21c respectively. The advantageous benefit of the invention is that all

lamps 27a, 27b, and 27c can operate in the same frequency by forming a first loop comprised of conductint wires 28a and 28b, a second loop comprised of conductint wires 28c and 28d, and a third loop comprised of conductint wires 28e and 28f and electrically connecting the first, the second, and the third loops together. Moreover, for obtaining a stable current of lamps, a well known current sampling and control technique is employed in which current sampling units 29a, 29b, and 29c for sampling lamp current, a control driving unit 201, a driving element 202, and a diode 203 are provided in the circuitry. This can carry out a feedback of lamp current.

Referring to Fig. 7, there is shown a schematic drawing of the circuitry of a frequency synchronization device for LCD according to a second preferred embodiment of the invention in which the LCD has more than three lamps (27a, 27b, 27c, 27e). The second preferred embodiment substantially has same structure as the first preferred embodiment. Thus a detailed description thereof is omitted herein for the sake of brevity.

The invention can carry out a frequency synchronization operation among a plurality of lamps of LCD and a stable operating current of the lamps without causing a difference frequency distortion. In brief, the frequency synchronization device for a large LCD having a plurality of lamps as background light source as contemplated by the invention has the following advantages: a) A secondary winding of multicoil of a transformer is used as means

for initiating and sending synchronous signals to the lamps so that all lamps can operate in the same frequency. b) Synchronous signals having the same frequency can be generated without the provision of ICs as experienced in the prior art. c) Both connection and circuitry of the frequency synchronization device are much simplified. d) The synchronous signals having the same frequency are generated by a resonant chamber consisting of transformers and capacitors. e) Typical lighting loop of a plurality of fluorescent lamps are incorporated into the circuitry of the invention and are improved by the invention. F) Availability of constituent components is much easy and thus the manufacturing cost is reduced significantly due to the above advantage of item e). g) The invention is applicable to an LCD having more than two lamps. h) Lamp current can be effectively controlled and stabilized by incorporating a cost-effective lamp control circuit. i) Finally, the invention is much simplified in terms of the frequency synchronization control of lamps.

While the invention herein disclosed has been described by means of specific embodiments, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope and spirit of the invention set forth in the claims.